STUDY ON STRENGTHENED INFILLED RC FRAME STRUCTURE USING BASALT FIBER REINFORCED CEMENT MORTAR

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ABSTRACT: *Reinforced Concrete (RC) framed structure is one of the primary shelters for industrial, public and commercial purposes. The main reason for selecting this structure is to protect human lives and materials under heavy load with long life period and also to support the environment effect. RC is made up of resources which are available very near to the construction field and can be mould into any required regular shapes. The main problem in RC frame structure is that it is made up of structural and non - structural elements. The main role of structural element is to carry the load and to distribute the load such as beam, column and slab. The structural element is designed with proper geometry along with materials to make the RC frame structure. The non - structural element is not designed because it does not behave as structural member and it carries only compressive force. Normally, RC frame structure is subjected to higher lateral load when compared to vertical load. So, the non - structural element like infilled wall is very weak under lateral load and it does not have interaction and less ductility when combined with structural element. The main objective of this work is to improve the interaction between frame elements and to increase the ductility of RC frame structure. Three specimens such as (i) Single bay, two storey RC bare frame (ii) Single bay, two storey infilled RC frame (iii) Single bay, two storey with reinforced infilled wall under basalt fiber in cement mortar were cast and tested. The experimental investigations were carried out with one-fifth model. The 100 ton loading frame was used to test these specimens and displacement was also measured with the help of Linear Variable Differential Transformer (LVDT). The ultimate load carrying capacity, stiffness, ductility, energy dissipation capacity and failure mechanism were observed. This paper aims at proving the point that by adding basalt fiber to the conventional cement mortar, the interaction between frame and infilled wall is enhanced and the ductility of RC frame structure is also increased.*

Keywords*: RC frame, Infilled, basalt fiber*

1. INTRODUCTION

Nowadays, the need of space for building is the prime importance throughout the world. It has made the construction of tall buildings grow in a rapid manner especially in the metropolitan cities. Reinforced Concrete (RC) mainly is used in the construction of commercial, industrial and multi-storey residential structures. Generally, RC structures consist of structural and non-structural components that may fulfill the design and architectural requirements. The structural form of multi-storey structure ideally involves the selection and arrangement of the major structural elements to resist the various combinations of gravity and lateral loading. Earthquakes, which occurred previously have proved that the structures are highly vulnerable. There are many numbers of buildings in urban areas which are moderate to severe seismic zones of the country. Hence, it is necessary to understand the response of structures and enhance such structures into an earthquake resistant based structure. It is also to prevent the collapse of structure, save the life and property.

2. INFILLED FRAMES

Masonry walls are commonly used as infilled wall in reinforced concrete framed structures in developing countries. Experience during the past earthquakes has confirmed the beneficial effects as well as the ill-effects of the presence of infill masonry walls. The brick is very most often for high rise and load bearing structures. It is a non-homogeneous material and it plays a crucial role in the performance of the structure. Brick masonry is strong in compression but weak in tension. In compression, the mortar in the brick masonry joints fail earlier than the bricks and thus the strength of mortar determines the strength of brickwork.

3. LITERATURE REVIEW

Manicka (2009) studied the approximate method for lateral load analysis of tall building. The existing approximate methods were reviewed succinctly. The defect in the traditional cantilever method was removed and a new guide line is postulated for reckoning the size of the areas of columns to be used for finding the centre of gravity and the moment of inertia of the combined columns. Finally, a method known as equivalent frame method was proposed for finding the terminal moments of tall building frames. The solution of the method fairly coincided with that of the improved cantilever method.

Rajasankar et al. (2010) presented the quasi-static analysis of reinforced concrete frame structures carried out using a continuum damage mechanics based model. The model was found to be sufficient to capture the physical changes in a RC frame member such as cracking and yielding under monotonic loading due to imposed lateral displacement.

Vijayakumar and Venkatesh (2012) evaluated the zone-III selected existing reinforced concrete building to conduct the non-linear static analysis. The pushover analysis showed the pushover curves, capacity spectrum, plastic hinges and performance level of the existing building. The non-linear static analysis gave better understanding and more accurate seismic performance of buildings as progression of damage or failure could be traced.

Chethan et al. (2010) studied the influence of masonry infill on fundamental natural frequency of RC frames. 2D RC frames of one bay and two bay having single storey, double storey and three storeys were cast and tested for bare frame and many combination of unreinforced masonry infill panels. Tri-axial shake table was used for testing of specimen. The details of the numerical analysis and experimentation were carried out and compare to each other in this research project.

Kashif et al. (2010) observed the behaviour of reinforced concrete frames with brick masonry infill with various parametric changes and determined the deformation patterns of the frame. In addition to this, non linear analysis was performed and instead of brick masonry infill other types of infill such as concrete block was also investigated.

Sevket et al. (2011) investigated the overall performance of hollow clay tile infilled reinforced concrete RC frames strengthened with carbon fiber-reinforced polymer materials in the experimental study. Results anddiscussions were presented on the basis of the observed global performance and local failure mechanism along with the detailed comparison of similar studies.

Table 1 Concrete Mix Proportion (M_{25})

Cement	Fine Aggregate	Coarse Aggregate
1	1.29	2.63

4. EXPERIMENTAL INVESTIGATION

The behaviour of various RC frame with infilled wall is studied through an experimental program. In this experimental program, the different types of specimens such as RC bare frame, infilled RC frame and infilled RC frame strengthened by reinforced cement mortar using basalt fiber are cast and tested. All the specimens are modeled as single-bay two-storey plane frame and it is modeled as one-fifth scale from the prototype structure. The specimens are subjected to lateral cyclic loading with the help of loading frame 100-tonne capacity. Before casting the specimens, the properties of materials are tested and utilized for designing, casting and testing of specimens. Quality and grade of materials are described in chapter 4. The strength of materials are achieved by various test conducted such as specific gravity of cement, fine aggregate and coarse aggregate, initial setting time on cement, compressive strength, split tensile strength and elastic modulus of concrete. All the test procedure helps to maintain the quality of specimen at the time of casting and testing program of the specimens. The details of the specimens and the experimental program are explained in this chapter. The objective of this investigation is to improve the performance of infilled RC frame structure by strengthening of cement mortar in infilled wall.

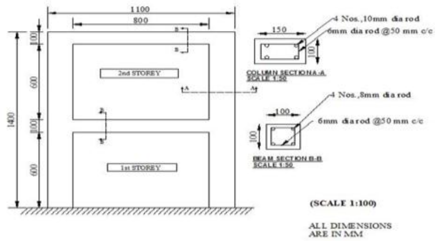

Fig. 1 Geometry details of RC bare frame

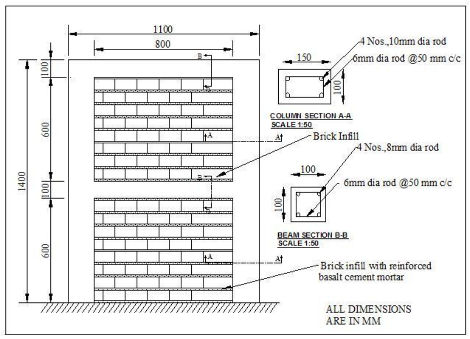

Fig.2 Geometry details of infilled RC frame with reinforced basalt cement mortar

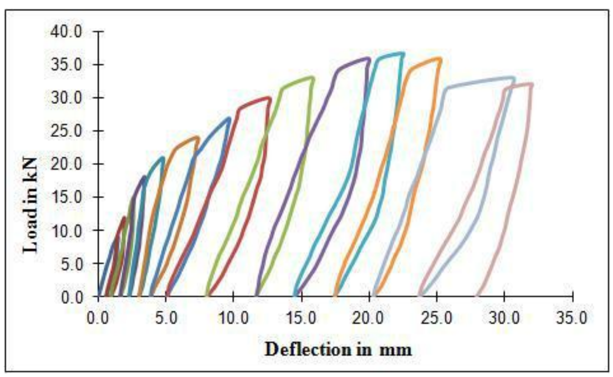

Fig.3 Load-deflection behaviour of infilled RC frame

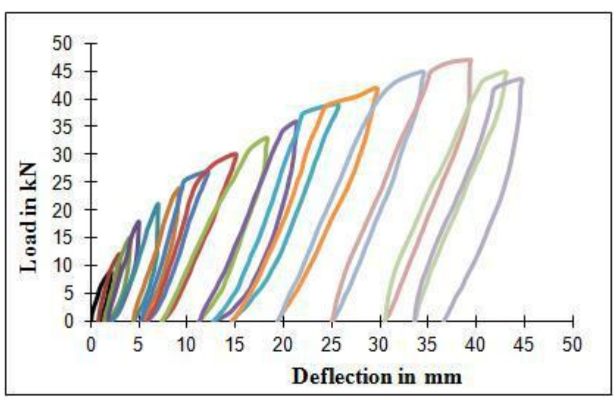

Fig.4 Load-deflection behaviour of Basalt fiber reinforced infilled RC frame

5. SUMMARY OF THE DIFFERENCE BETWEEN INFILLED RC FRAME AND RC FRAME WITH REINFORCED INFILLED WALL

1. The ultimate load carrying capacity of RC frame with reinforced infilled wall is 27.71% higher than that of infilled RC frame.

2. Difference in percentage of results of the ultimate load for both theoretical and experimental investigation is within acceptable limits.

3. The initial stiffness of reinforced infilled RC frame is 1.33 times greater than infilled RC frame.

4. The cumulative energy dissipation capacity of fiber reinforced infilled RC frame is 1.68 times higher than that of infilled RC frame.

5. Strengthening of cement mortar by addition of fiber reduces the crack between the column and the infilled wall.

6. Ductility of fiber reinforced infilled RC frame is 2.23 times greater than that of infilled RC frame.

7. Typically, infilled wall does not carry the load throughout the section but fiber reinforced cement mortar supports for distributing the load throughout the section.

8. From the theoretical analysis, the hinge mechanism is used to observe the yield and ultimate load of specimens.

REFERENCES

1. Sevket Ozden, Umut Akguzel & Turun Ozturan 2011, 'Seismic strengthening of infilled reinforced concrete frames with composite materials', ACI Structural Journal, vol. 108, no. 4, pp. 414-422.

2. Sumathi, A & Saravana Raja Mohan, K 2014, 'Study on the effect of compressive strength of brick masonry with admixed mortar', International Journal of ChemTech Research, vol. 6, no. 7,3437-3450.

3. Vijayakumar, A & Venkatesh Babu, DL 2012, 'Pushover analysis of existing reinforced concrete frame structures', European Journal of Scientific Research, vol. 71, no. 2, pp. 195-202.

4. Wakchaure, MR & Ped, SP 2012, 'Earthquake analysis of high rise building with and without infilled walls', International Journal of Engineering and Innovative Technology, vol. 2, no. 2, pp. 89-94.

5. Yuksel, E, Ozkaynak, H, Buyukozturk, O, Yalcin, C, Dindar, AA, Surmeli, M & Tastan, D 2010, 'Performance of alternative CFRP retrofitting schemes used in infilled RC frames', Construction and Building Materials, vol. 24, pp. 596-609.

6. Berk Ozsayin, Emre Yilmaz, Medine Ispir, Hasan Ozkaynak, Ercan Yuksel & Alper Ilki 2011, 'Characteristics of CFRP retrofitted hollow brick infill walls of reinforced concrete frames', Construction and Building Materials, vol. 25, pp. 4017-4024.

7. Chethan, K, Ramesh Babu, R, Katta venkataramana & Akanshu Sharma 2010, 'Influence of masonry infill on fundamental natural frequency of 2D RC frames', Journal of Structural Engineering, vol. 37, no. 2, pp. 135-141.

8. Diware, VV & Saoji, AC 2012, 'Seismic assessment of symmetrical RC structure with brick masonry infills', International Journal of Engineering Research and Applications, vol. 2, no. 3, pp. 2573-2577.

9. Haroon Rasheed Tamboli & Umesh N Karadi 2012, 'Seismic analysis of RC frame structure with and without masonry infill walls', Indian Journal of Natural Sciences, vol. 3, no. 14, pp. 1137-1148.

10. IS: 12269, 1987, 'Specification for 53 grade ordinary Portland cement', BIS, New Delhi, India.